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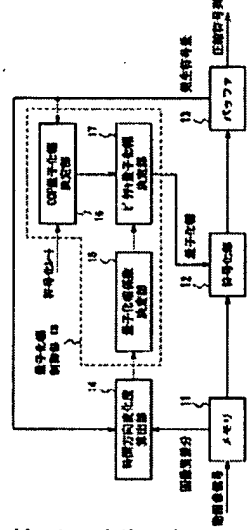
Abstract:
PROBLEM TO BE SOLVED: To keep picture quality of each picture to be uniform in coding a moving image by combining an I picture, a P picture and a B picture.SOLUTION: A time direction change degree calculating section 14 calculates a time direction change degree of a moving image signal on the basis of input image data of a memory 11 and the information of produced code quantity of a buffer 13. A quantization width control section 18 consists of a quantization width coefficient calculating section 15, a GOP quantization width determining section 16, and a picture quantization width determining section 17. The section 18 determines the quantization width of a picture to be coded, by using reference quantization width of the GOP determined on the basis of a prescribed coding rate and the transition of produced code quantity in the buffer 13, and a quantization width coefficient of each picture type calculated from the time direction change degree.



JPO Machine translation abstract:
(57) **Abstract**
SUBJECT It aims at keeping the image quality of each picture uniform in the video coding which combined I picture, P picture, and B picture.
Means for Solution The time direction change degree calculation part 14 computes the degree of time direction change of a dynamic image signal based on information on inputted image data of the memory 11, and a generated code amount of the buffer 13. Basis child-ized width of GOP which the quantization width control section 18 was constituted from the quantization width coefficient calculation part 15, the GOP quantization width deciding part 16, and the picture

quantization width deciding part 17, and was calculated from transition of a generated code amount in a predetermined encoding rate and the buffer 13, Quantization width of a picture made into a coding subject is determined using a quantization width coefficient of each picture type computed from the above-mentioned degree of time direction change.

Claim(s)

Claim 1 In video coding equipment which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, Video coding equipment provided with a time direction change degree calculating means which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.

Claim 2 Video coding equipment when said degree of time direction change is small in the video coding equipment according to claim 1, wherein said quantization width control means makes quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding.

Claim 3 Video coding equipment, wherein said time direction change degree calculating means computes said degree of time direction change in the video coding equipment according to claim 1 using difference information between pictures in an inputted dynamic image signal.

Claim 4 Video coding equipment, wherein said time direction change degree calculating means computes said degree of time direction change in the video coding equipment according to claim 1 using information on a code amount assigned before coding, and a generated code amount obtained after coding.

Claim 5 Video coding equipment, wherein said time direction change degree calculating means computes said degree of time direction change in the video coding equipment according to claim 1 using information on a motion vector and information on coding mode which are acquired at the time of coding.

Claim 6 In video coding equipment which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, Video coding equipment provided with an image evaluation value calculating means which computes an image evaluation value to a decoded image of said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.

Claim 7 Video coding equipment, wherein said image evaluation value calculating means computes said image evaluation value in the video coding equipment according to claim 6 using a difference quantity between images of an inputted dynamic image signal and a decoded image obtained at the time of coding.

Claim 8 Video coding equipment, wherein said image evaluation value calculating means computes said image evaluation value in the video coding equipment according to claim 6 using a S/N ratio of an inputted dynamic image signal and a decoded image obtained at the time of coding.

Claim 9 In a video encoding method which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, A video encoding method including a time direction change degree calculating process which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.

Claim 10A video encoding method when said degree of time direction change is small in the video encoding method according to claim 9, wherein said quantization width control process makes quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding.

Claim 11A video encoding method, wherein said time direction change degree calculating process computes said degree of time direction change in the video encoding method according to claim 9 using difference information between pictures in an inputted dynamic image signal.

Claim 12A video encoding method, wherein said time direction change degree calculating process computes said degree of time direction change in the video encoding method according to claim 9 using information on a code amount assigned before coding, and a generated code amount obtained after coding.

Claim 13A video encoding method, wherein said time direction change degree calculating process computes said degree of time direction change in the video encoding method according to claim 9 using information on a motion vector and information on coding mode which are acquired at the time of coding.

Claim 14A video encoding method which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, comprising:

An image evaluation value calculating process which computes an image evaluation value to a decoded image of said dynamic image signal.

A quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.

Claim 15A video encoding method, wherein said image evaluation value calculating process computes said image evaluation value in the video encoding method according to claim 14 using a difference quantity between images of an inputted dynamic image signal and a decoded image obtained at the time of coding.

Claim 16A video encoding method, wherein said image evaluation value calculating process computes said image evaluation value in the video encoding method according to claim 14 using a S/N ratio of an inputted dynamic image signal and a decoded image obtained at the time of coding.

Claim 17A recording medium recording a video encoding program which performs the video encoding method according to any one of claims 9 to 16.

Claim 18A recording medium recording a stream coded by the video coding equipment according to any one of claims 1 to 8.

Claim 19 It is the method of decoding a stream coded by the video coding equipment according to any one of claims 1 to 8, When decoding the above-mentioned stream, a dynamic image signal is considered as an input, A video decoding method decoding using a decoding device which decodes a stream coded in said dynamic image signal by video coding equipment which chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and is coded.

Detailed Description of the Invention

0001

Field of the Invention Especially this invention relates to the thing aiming at improvement of the video coding equipment which compresses dynamic image data highly efficiently about video coding equipment, a video encoding method, a recording medium, and a video decoding method.

0002

Description of the Prior Art As coding technology which compresses dynamic image data highly efficiently, the video encoding method which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded is known, for example like MPEG 2.

0003 The screen (I picture is called hereafter) formed into the screen inner code in such a video encoding method, Since the screen (P picture is called hereafter) which carried out forward prediction coding, and the screen (B picture is called hereafter) which carried out bidirectional prediction coding are intermingled, in order to realize highly efficient coding, rate control which assigns a code amount appropriately according to the kind of picture made into a coding subject is needed.

0004 By rate control adopted by TM5 (Test Model 5) of MPEG 2, the ratio of the quantization width of I picture, P picture, and B picture is specified as Ki:Kp:Kb=1:1:1.4, The quota code amount of each picture is computed from the quota code amount of GOP (Group of Pictures) based on the ratio of the above-mentioned quantization width.

0005

Problem(s) to be Solved by the Invention However, since the ratio of the quantization width in each picture is set always constant in the above-mentioned rate control, depending on a dynamic image signal, image quality may not become uniform.

0006 For example, in image sequences with a small time change of a dynamic image signal, since the quota code amount of I picture is insufficient, the image quality of I picture may worsen relatively compared with the image quality of P picture and B picture, and the badness of the image quality of I picture may be visually conspicuous.

0007 This invention was made in order to solve the problem of the above conventional things, and an object of this invention is to provide the video coding equipment which can equalize the image quality of each picture in coding of a dynamic image signal, a video encoding method, a recording medium, and a video decoding method.

0008

Means for Solving the Problem In order to solve this SUBJECT, the invention of an application concerned according to claim 1, In video coding equipment which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It has a time direction change degree calculating means which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.

0009 In the video coding equipment according to claim 1, the invention of an application concerned according to claim 2 is made to make quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding, when said degree of time direction change of said quantization width control means is small.

0010 In the video coding equipment according to claim 1, as for the invention of an application concerned according to claim 3, said time direction change degree calculating means computes said degree of time direction change using difference information between pictures in an inputted dynamic image signal.

0011 The invention of an application concerned according to claim 4 computes said degree of time direction change in the video coding equipment according to claim

1 using information on a code amount which assigned said time direction change degree calculating means before coding, and a generated code amount obtained after coding.

0012 The invention of an application concerned according to claim 5 computes said degree of time direction change in the video coding equipment according to claim 1 using information on a motion vector and information on coding mode that said time direction change degree calculating means is acquired at the time of coding.

0013 In video coding equipment which the invention of an application concerned according to claim 6 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It has an image evaluation value calculating means which computes an image evaluation value to a decoded image of said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.

0014 The invention of an application concerned according to claim 7 computes said image evaluation value in the video coding equipment according to claim 6 using a difference quantity between images of a decoded image in which said image evaluation value calculating means is acquired at the time of an inputted dynamic image signal and coding.

0015 The invention of an application concerned according to claim 8 computes said image evaluation value in the video coding equipment according to claim 6 using a S/N ratio of a decoded image in which said image evaluation value calculating means is acquired at the time of an inputted dynamic image signal and coding.

0016 In a video encoding method which the invention of an application concerned according to claim 9 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It is made to include a time direction change degree calculating process which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.

0017 In the video encoding method according to claim 9, the invention of an application concerned according to claim 10 is made to make quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding, when said degree of time direction change of said quantization width control process is small.

0018 In the video encoding method according to claim 9, as for the invention of an application concerned according to claim 11, said time direction change degree calculating process computes said degree of time direction change using difference information between pictures in an inputted dynamic image signal.

0019 The invention of an application concerned according to claim 12 computes said degree of time direction change in the video encoding method according to claim 9 using information on a code amount which assigned said time direction change degree calculating process before coding, and a generated code amount obtained after coding.

0020 The invention of an application concerned according to claim 13 computes said degree of time direction change in the video encoding method according to claim 9 using information on a motion vector and information on coding mode that said time direction change degree calculating process is acquired at the time of coding.

0021 In a video encoding method which the invention of an application concerned according to claim 14 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It is made to include an image evaluation value calculating process which computes an image evaluation value to a decoded image of said dynamic image signal, and a quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.

0022 The invention of an application concerned according to claim 15 computes said image evaluation value in the video encoding method according to claim 14 using a difference quantity between images of a decoded image in which said image evaluation value calculating process is acquired at the time of an inputted dynamic image signal and coding.

0023 The invention of an application concerned according to claim 16 computes said image evaluation value in the video encoding method according to claim 14 using a S/N ratio of a decoded image in which said image evaluation value calculating process is acquired at the time of an inputted dynamic image signal and coding.

0024 The invention of an application concerned according to claim 17 records a video encoding program which performs the video encoding method according to any one of claims 9 to 16.

0025 The invention of an application concerned according to claim 18 records a stream coded by the video coding equipment according to any one of claims 1 to 8.

0026 The invention of an application concerned according to claim 19 is the method of decoding a stream coded by the video coding equipment according to any one of claims 1 to 8, When decoding the above-mentioned stream, a dynamic image signal is considered as an input and it is made to decode using a decoding device which decodes a stream coded in said dynamic image signal by video coding equipment which chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and is coded.

0027

Embodiment of the Invention Hereafter, an embodiment of the invention is described using Drawings.

0028(Embodiment 1) Drawing 1 shows an example of the embodiment of the video coding equipment in the invention of an application concerned according to any one of claims 1 to 4. This video coding equipment performs quantization width control by performing the video encoding method in the invention of an application concerned according to any one of claims 9 to 12.

0029 In drawing 1, the inputted dynamic image signal is stored in the memory 11 for picture storing. The image data stored in the memory 11 is held after being rearranged into an order of performing coding until it is coded. For example, if the kind of picture is specified like drawing 3 to the picture stored in the memory 11, an order to code will serve as the I picture I1, the P picture P4, B picture B-2, the B picture B3, the P picture P7, B picture B5, and B picture B6.

0030 In drawing 3, the I picture I1 is formed into a screen inner code, the P picture P4 uses the I picture I1 as an image comparison, forward prediction coding is carried out, and bidirectional prediction coding of both B picture B-2 and B3 is carried out by using the I picture I1 and the P picture P4 as an image comparison. Furthermore, forward prediction coding is carried out by using the P picture P4 as an image comparison, both B picture B5 and B6 use the P pictures P4 and P7 as an image comparison, and bidirectional prediction coding of the P picture P7 is carried out. On the other hand, the difference information between the pictures acquired from the image data of the memory 11 is sent to the time direction change degree calculation part 14, and is used as information for computing the degree of time direction change of a dynamic image signal.

0031 The coding part 12 codes the image data memorized by the memory 11 with the quantization width given from the quantization width control section 18, and outputs a compression code sequence to the buffer 13. The time direction change degree calculation part 14 computes the degree of time direction change of a dynamic image signal based on the difference information between the pictures acquired from the image data of the memory 11, and the information on the generated code amount in the buffer 13. The quantization width control section 18 comprises the quantization width coefficient deciding part 15, the GOP quantization width deciding part 16, and the picture quantization width deciding part 17. The quantization width coefficient deciding part 15 responds to the degree of time direction change of the dynamic image signal computed by the time direction change degree calculation part 14, and is a quantization width coefficient () of each picture. **Ki and** Determine Kp and Kb and the GOP quantization width deciding part 16, Determining the basis child-ized width in GOP based on transition of the generated code amount in a predetermined encoding rate and the buffer 13, the picture quantization width deciding part 17 determines the quantization width of the picture made into a coding subject from the basis child-ized width of GOP, and the quantization width coefficient of each picture.

0032 The case where image sequences with the small degree of time direction change are hereafter coded by the encoding order of drawing 3 is explained. In the encoding order of drawing 3, the inputted picture is coded in order of the I picture I1, the P picture P4, B picture B-2, and the B picture B3. Here, supposing distribution of the code amount assigned to each picture is unsuitable and sufficient code amount for the I picture I1 is not assigned, the quantization width of the I picture I1 becomes large, and sufficient image quality will be obtained in the I picture I1. On the other hand, since the prediction error signal after motion compensation prediction is also small when the degree of time direction change is small, it can quantize finely enough, and the P picture P4 which uses the I picture I1 as an image comparison can obtain the image quality near **picture / I1 / I** an inputted image. As for B picture B-2 and the B picture B3, the prediction error signal after motion compensation prediction becomes small similarly, and image quality equivalent to the P picture P4 is obtained. As a result, in the above-mentioned decoded image, the bad image of image quality will appear with the cycle of I picture, and the unevenness of image quality will be visually conspicuous.

0033 Then, it considers enlarging relatively the code amount assigned to the I picture I1. The I picture I1 serves as image quality near an inputted image compared with the case where quantization width becomes small and only the part whose quota code amount increased is ****. Since the image quality of the I picture I1 used as an image comparison improves about the P picture P4, the prediction error signal after motion compensation prediction becomes still smaller, and where equivalent image quality is maintained, it can reduce a generated code amount. About B picture B-2 and B3, the prediction error signal after motion compensation prediction becomes small similarly, and image quality equivalent to the P picture P4 is obtained.

0034 The generated code amount at the time of amending a generated code amount when the quota code amount of the I picture I1 is not enough so that the quota code amount of the I picture I1 may be increased more than drawing 4 (a) in drawing 4 (b) again is shown in drawing 4 (a). In drawing 4, although the generated code amount of the I picture I1 has more drawing 4 (b), the direction of the generated code amount of the P picture P4 of drawing 4 (b) which uses the good I picture I1 of image quality as an image comparison has decreased. In the case of both, the total generated code amount at this time is almost the same.

0035 The S/N ratio in the case of both is shown in drawing 5. Since drawing 5 (a) of the quota code amount of the I picture I1 is insufficient, the S/N ratio is getting worse compared with other pictures, but in drawing 5 (b), the S/N ratio of the I picture I1 is improved, and it turns out that image quality is almost uniform.

0036 The example of the method of computing the degree of time direction change to below by the time direction change degree calculation part 14, and determining the quantization width coefficient Ki of I picture as it by the quantization width coefficient deciding part 15 is shown. In this method, the difference information between the pictures in a dynamic image signal and the information on the generated code amount obtained after coding are used.

0037 First, in the time direction change degree calculation part 14, it asks for image data F1 of the memory 11, and the difference D between the pictures in F2 by

(several 1), and the degree Z1 of time direction change is computed by (several 2) from this result.
0038
Equation 1

For drawings please refer to the original document.

Equation 2

For drawings please refer to the original document.

However, F1 (x, y) and F2 (x, y) are the difference values of picture F1 in coordinates (x, y), the picture element data (It is usually luminance data) of F2, the pixel number from which Npixel constitutes the picture of one sheet, and the maximum which can be regarded as the degree of time direction change of Dt being small. For example, it will be referred to as Dt=5, if it supposes that the degree of time direction change is small when it is five or less difference in the difference value of a luminance level. Therefore, picture F1 and the difference D of F2 are set to 0 <=Z1<1 when smaller than Dt, and they can judge that the degree of time direction change is small.
0039 Next, the degree Z2 of time direction change is calculated from (several 3) and (several 4) based on the generated code amount Spbb and the GOP quota code amount Tgop which are measured with the buffer 13.
Equation 3

For drawings please refer to the original document.

Equation 4

For drawings please refer to the original document.

However, Spbb is the sum of a set of three new generated code amounts in time among the components (P picture / B picture / B picture should put together by encoding order) of one P picture and two B pictures. Cp and Cb express the anticipation generated code amount of P picture when the anticipation generated code amount of I picture is set to 1, and B picture, respectively, for example, set up a value like Cp=0.5 and Cb=0.25. Tpbb is an anticipation quota code amount distributed to one P picture and two B pictures, and is calculated using the anticipation generated code amount ratios Cp and Cb of P picture and B picture defined by the GOP quota code amount Tgop and the above. Therefore, when there are few generated code amounts of one P picture and two B pictures than an anticipation quota code amount, it is set to 0 <=Z2<1, and it can be judged that the degree of time direction change is small.
0040 In the quantization width coefficient deciding part 15, (several 5) determines the quantization width coefficient Ki of I picture using the degrees Z1 and Z2 of time direction change for which it asked by (several 2) and (several 4).
Equation 5

For drawings please refer to the original document.

However, "=" in (several 5) means substitution. w1 and w2 are the weighting factors to the degrees Z1 and Z2 of time direction change, respectively, for example, they are defined like 0 <=w1+w2 <=0.2. It may be for defining the upper limit of w1+w2 preventing superfluous amendment of quantization width here, and this value may not be 0.2.
0041 The image quality of I picture can be brought close to the image quality of P picture and B picture by amending the quantization width coefficient Ki and adjusting the quantization width of I picture with the above method.
0042 Namely, the quantization width coefficient deciding part 15 determines the quantization width coefficient of each picture type from the above-mentioned degree of time direction change, From transition of the generated code amount in a predetermined encoding rate and the buffer 13, the GOP quantization width deciding part 16 determines the basis child-ized width of GOP, and by the picture quantization width deciding part 17. When the quantization width of the picture made into a coding subject from the basis child-ized width of these GOP and the quantization width coefficient of each picture is determined and the coding part 12 codes with the quantization width given from the quantization width control section 18, The image quality of I picture can be brought close to the image quality of P picture and B picture.
0043 Although Ki was amended and quantization width of I picture was adjusted by an above-mentioned method, Kp and Kb may be amended and quantization width of P picture or B picture may be adjusted.
0044 Thus, according to this Embodiment 1, image quality of I picture, P picture, and B picture can be made uniform by controlling quantization width of each picture according to the degree of time direction change of a dynamic image signal. In a dynamic image signal especially with the small degree of time direction change, degradation of image quality produced with a cycle of I picture can be prevented.
0045 Although difference information between pictures of a dynamic image signal and information on a generated code amount obtained after coding were used as information for computing the degree of change of a time direction in this embodiment, For example, like information on a motion vector obtained at the time of coding, or information on coding mode (it corresponds to Claim 5 and 13), as long as it is information with the degree of time direction change of a dynamic image signal, and correlation, what kind of information may be used. The example is indicated to be (several 6) to (several 7).
0046
Equation 6

For drawings please refer to the original document.

Equation 7

For drawings please refer to the original document.

However, MV (i, j) is a macro block number from which a motion vector of each macro block, and Rx and Ry constitute a search range of a motion vector, MD (i, j) constitutes coding mode (if it is intra coding and is 1 and inter encoding 0) of each macro block, and Nmb constitutes a picture. The degree Z1 of time direction change calculated by (several 6) is the value which normalized average size of a motion vector in a picture made into a coding subject in the range of 0 to 1, and it can be said that change of image sequences is small, so that Z1 is **zero** near. It can be said that it expresses a rate of intra coding of a picture made into a coding subject, its a possibility that motion prediction will come true is so high that Z2 is **zero** near as for the degree Z2 of time direction change calculated by (several 7), and its change of image sequences is small.
0047 The quantization width Ki of I picture can be amended by applying Z1 and Z2 which were obtained by (several 6) and (several 7) to (several 5). Thus, average size and a rate of intra coding of a motion vector can also be used as one measure of the degree of time direction change.
0048(Embodiment 2) Drawing 2 shows an example of an embodiment of video coding equipment in the invention according to claim 6 or 7. This video coding equipment performs quantization width control by performing a video encoding method in the invention of an application concerned according to claim 14 or 15.
0049 In drawing 2, the memory 21, the coding part 22, and the buffer 23 have the respectively same function as the memory 11 of drawing 1, the coding part 12, and the buffer 13. The image evaluation value calculation part 24 computes an image evaluation value in a decoded image of each picture from inputted image data stored in the memory 21, and local decoding image data generated in the coding part 22. The quantization width control section 28 comprises the quantization width coefficient deciding part 25, the GOP quantization width deciding part 26, and the picture quantization width deciding part 27, Among these, the GOP quantization width deciding part 26 and the picture quantization width deciding part 27 have the respectively same function as the GOP quantization width deciding part 16 of drawing 1, and the picture quantization width deciding part 17. The quantization width coefficient deciding part 25 determines a quantization width coefficient (Ki, Kp, Kb) to each picture so that image quality of each picture may become uniform based on an image evaluation value computed by the image evaluation value calculation part 24.
0050 An example of a method of computing an image evaluation value to below by the image evaluation value calculation part 24, and determining a quantization width coefficient of each picture as it by the quantization width coefficient deciding part 25 is shown. In this method, a difference quantity between images of an inputted image and a decoded image (error) is used as an image evaluation value.
0051 First, in the image evaluation value calculation part 24, the error E in the inputted image Fin and the decoded image Fdec is searched for by (several 8) from

each picture of a just before GOP, and then the average error Ec of each picture type (I, P, B) and the average error Egop in the whole GOP are calculated by (several 9) and (several 10).
0052
Equation 8

For drawings please refer to the original document.

Equation 9

For drawings please refer to the original document.

Equation 10

For drawings please refer to the original document.

However, the number of pictures of each picture type and Ngop of the pixel number and Nc from which Npixel constitutes a picture are the numbers of pictures of GOP.
0053 Next, in the quantization width coefficient deciding part 25, the average error Ec of each picture type is compared with the average error Egop in the whole GOP. If the average error Ei of I picture is larger than the average error Egop of GOP, image quality of I picture will judge relatively that it is bad, and the quantization width coefficient Ki of I picture will be amended so that it may become small. Amendment with the same said of P picture and B picture is performed. (Several 11) and (several 12) perform amendment of a quantization width coefficient in each picture type.
0054
Equation 11

For drawings please refer to the original document.

Equation 12

For drawings please refer to the original document.

However, "=" in (several 12) means substitution. A threshold for Et to normalize an image evaluation value in the range of -1 to 1 and Zc are the weighting factors of an image evaluation value, for example, define the image evaluation value of each picture type, and w like 0<=w<=0.2. It may be for defining the upper limit of w preventing superfluous amendment of quantization width here, and this value may not be 0.2.
0055 Image quality of I picture can be brought close to image quality of P picture and B picture by amending the quantization width coefficient Ki and adjusting quantization width of I picture with the above method. It is the same also about P picture and B picture.
0056 Namely, the quantization width coefficient deciding part 25 determines a quantization width coefficient of I picture from an average error of I picture, and an average error in the whole GOP, From transition of a generated code amount in a predetermined encoding rate and the buffer 13, the GOP quantization width deciding part 26 determines basis child-ized width of GOP, and by the picture quantization width deciding part 27. When quantization width of a picture made into a coding subject from basis child-ized width of these GOP and a quantization width coefficient of I picture is determined and the coding part 22 codes with quantization width given from the quantization width control section 28, Image quality of I picture can be brought close to image quality of P picture and B picture. It is the same also about P picture and B picture.
0057 Thus, by according to this Embodiment 2, computing an image evaluation value in a decoded image of a coded dynamic image signal, and carrying out the direct valuation of the image quality about each of I picture, P picture, and B picture, Feedback control which enables coding which becomes uniform **image quality of each picture** becomes possible.
0058 In this Embodiment 2, although process delay and memory space are reducible by performing calculation processing with error to an inputted image and a decoded image by a macro block unit, a frame unit or GOP units may be sufficient as calculation processing with error.
0059 In this Embodiment 2, although image evaluation of a decoded image is performed by making GOP into a unit, the unit in particular of image evaluation may not be GOP. As long as it is the information which can evaluate image quality of a decoded image also about information used for image evaluation, for example like a S/N ratio (it corresponds to Claim 8 and 16) only in a difference quantity between images of an inputted image and a decoded image, what kind of information may be sufficient.
0060 In above Embodiments 1 and 2, although it was the GOP structure (M is an insertion interval of I picture or P picture, and N is the number of pictures of GOP) of M= 3 and N= 15, and a case where picture structure was the frame structure was mentioned as an example and explained, a different value may be sufficient as M and N. The frame structure or field structure may be sufficient as picture structure of each picture.
0061 This invention can be carried out as coding equipment on a computer system by a program's realizing and recording this on a recording medium (it corresponds to Claim 17).
0062 As shown in drawing 6, a recording medium which recorded a coding stream which can be decoded by uniform image quality is obtained by recording a stream coded in the above-mentioned coding equipment 100 on the recording medium 200 (it corresponds to Claim 18).
0063 In reproducing a stream which once recorded this stream itself or this that was coded on a recording medium, and was reproduced, It is possible not to need a device special as the decoding device 300, but to reproduce this with a decoding device corresponding to conventional coding equipment and same decoding device, and it is possible to perform the decoding by uniform image quality moreover (it corresponds to Claim 19).
0064 In order that the Reason may equalize assignment of a code amount under a premise that coding by this invention chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes, It is because a decoding device only chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding and should just support a coding mode.
0065
Effect of the Invention As mentioned above, according to the video coding equipment concerning the invention of an application concerned according to claim 1. In the video coding equipment which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The time direction change degree calculating means which computes the degree of change of the time direction in said dynamic image signal, Since it had the quantization width control means which controls the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change, The advantageous effect that the video coding equipment which can equalize image quality in the case of decoding is realizable is acquired by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.
0066 According to the video coding equipment concerning the invention of an application concerned according to claim 2, in the video coding equipment according to claim 1 said quantization width control means, When said degree of time direction change is small, since it was made to make quantization width small relatively to forward prediction coding and bidirectional prediction coding, the quantization width of the formation of a screen inner code, When the degree of time direction change is small, by making quantization width of I picture small relatively, the advantageous effect that the video coding equipment which can prevent the unevenness of the image quality generated I picture cycle in the case of decoding is realizable is acquired.
0067 According to the video coding equipment concerning the invention of an application concerned according to claim 3, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the difference information between the pictures in the inputted dynamic image signal, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired.
0068 According to the video coding equipment concerning the invention of an application concerned according to claim 4, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the information on the code amount assigned before coding, and the generated code amount obtained after coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which raises the homogeneity of image quality in the case of decoding is realizable is acquired.
0069 According to the video coding equipment concerning the invention of an application concerned according to claim 5, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the information on a motion vector and the information on coding mode which are acquired at the time of coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired.

0070 According to the video coding equipment concerning the invention of an application concerned according to claim 6. In the video coding equipment which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The image evaluation value calculating means which computes the image evaluation value to the decoded image of said dynamic image signal, Since it had the quantization width control means which controls the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value, The advantageous effect that the video coding equipment which can equalize image quality in the case of decoding is realizable is acquired by computing the image evaluation value of the local decoding image of a dynamic image signal, and carrying out feedback control of the quantization width of each picture according to this image evaluation value.
0071 According to the video coding equipment concerning the invention of an application concerned according to claim 7, in the video coding equipment according to claim 6 said image evaluation value calculating means, Since said image evaluation value was computed using the difference quantity between images of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.
0072 According to the video coding equipment concerning the invention of an application concerned according to claim 8, in the video coding equipment according to claim 6 said image evaluation value calculating means, Since said image evaluation value was computed using the S/N ratio of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.
0073 According to the video encoding method concerning the invention of an application concerned according to claim 9. In the video encoding method which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The time direction change degree calculating process which computes the degree of change of the time direction in said dynamic image signal, Since it was made to include the quantization width control process of controlling the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change, The advantageous effect that the video encoding method which can equalize image quality in the case of decoding is realizable is acquired by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.
0074 According to the video encoding method concerning the invention of an application concerned according to claim 10, in the video encoding method according to claim 9 said quantization width control process, When said degree of time direction change is small, since it was made to make quantization width small relatively to forward prediction coding and bidirectional prediction coding, the quantization width of the formation of a screen inner code, When the degree of time direction change is small, by making quantization width of I picture small relatively, the advantageous effect that the video encoding method which can prevent the unevenness of the image quality generated I picture cycle in the case of decoding is realizable is acquired.
0075 According to the video encoding method concerning the invention of an application concerned according to claim 11, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the difference information between the pictures in the inputted dynamic image signal, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.
0076 According to the video encoding method concerning the invention of an application concerned according to claim 12, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the information on the code amount assigned before coding, and the generated code amount obtained after coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.
0077 According to the video encoding method concerning the invention of an application concerned according to claim 13, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the information on a motion vector and the information on coding mode which are acquired at the time of coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.
0078 According to the video encoding method concerning the invention of an application concerned according to claim 14. In the video encoding method which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The image evaluation value calculating process which computes the image evaluation value to the decoded image of said dynamic image signal, Since it was made to include the quantization width control process of controlling the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value, The advantageous effect that the video encoding method which can equalize image quality in the case of decoding is realizable is acquired by computing the image evaluation value of the local decoding image of a dynamic image signal, and carrying out feedback control of the quantization width of each picture according to this image evaluation value.
0079 According to the video encoding method concerning the invention of an application concerned according to claim 15, in the video encoding method according to claim 14 said image evaluation value calculating process, Since said image evaluation value was computed using the difference quantity between images of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video encoding method which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.
0080 According to the video encoding method concerning the invention of an application concerned according to claim 16, in the video encoding method according to claim 14 said image evaluation value calculating process, Since said image evaluation value was computed using the S/N ratio of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video encoding method which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.
0081 Since the video encoding program which performs the video encoding method according to any one of claims 9 to 16 was recorded according to the recording medium concerning the invention of an application concerned according to claim 17, It is effective in the recording medium in which the encoding program which can equalize image quality was mentioned on the occasion of decoding being obtained by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.
0082 Since the stream coded by the video coding equipment according to any one of claims 1 to 8 was recorded according to the recording medium concerning the invention of an application concerned according to claim 18, It is effective in the recording medium in which the coding stream which can be decoded was mentioned by uniform image quality on the occasion of decoding being obtained.
0083 According to the video decoding method concerning the invention of an application concerned according to claim 19. It is the method of decoding the stream coded by the video coding equipment according to any one of claims 1 to 8, Since it was made to decode using the decoding device which decodes the stream which considered the dynamic image signal as the input and was coded in said dynamic image signal by the video coding equipment which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded when decoding the above-mentioned stream, It is not necessary to use the special decoding device corresponding to the coding equipment which can equalize such decoding image quality. If it is a decoding device corresponding to the stream coded by the video coding equipment which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded, a dynamic image signal only, There is an effect that decoding of the coding stream which can be decoded can be performed by uniform image quality and that a video decoding method is acquired.

Field of the Invention Especially this invention relates to the thing aiming at improvement of the video coding equipment which compresses dynamic image data highly efficiently about video coding equipment, a video encoding method, a recording medium, and a video decoding method.

Description of the Prior Art As coding technology which compresses dynamic image data highly efficiently, the video encoding method which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded is known, for example like MPEG 2.
0003 The screen (I picture is called hereafter) formed into the screen inner code in such a video encoding method, Since the screen (P picture is called hereafter) which carried out forward prediction coding, and the screen (B picture is called hereafter) which carried out bidirectional prediction coding are intermingled, in order to realize highly efficient coding, rate control which assigns a code amount appropriately according to the kind of picture made into a coding subject is needed.
0004 By rate control adopted by TM5 (Test Model 5) of MPEG 2, the ratio of the quantization width of I picture, P picture, and B picture is specified as Ki:Kp:Kb=1:1:1.4, The quota code amount of each picture is computed from the quota code amount of GOP (Group of Pictures) based on the ratio of the above-mentioned quantization width.

Effect of the Invention As mentioned above, according to the video coding equipment concerning the invention of an application concerned according to claim 1. In the video coding equipment which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The time direction change degree calculating means which computes the degree of change of the time direction in said dynamic image signal, Since it had the quantization width control means which controls the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change, The advantageous effect that the video coding equipment which can equalize image quality in the case of decoding is realizable is acquired by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.

0066 According to the video coding equipment concerning the invention of an application concerned according to claim 2, in the video coding equipment according to claim 1 said quantization width control means, When said degree of time direction change is small, since it was made to make quantization width small relatively to forward prediction coding and bidirectional prediction coding, the quantization width of the formation of a screen inner code, When the degree of time direction change is small, by making quantization width of I picture small relatively, the advantageous effect that the video coding equipment which can prevent the unevenness of the image quality generated I picture cycle in the case of decoding is realizable is acquired.

0067 According to the video coding equipment concerning the invention of an application concerned according to claim 3, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the difference information between the pictures in the inputted dynamic image signal, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired.

0068 According to the video coding equipment concerning the invention of an application concerned according to claim 4, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the information on the code amount assigned before coding, and the generated code amount obtained after coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which raises the homogeneity of image quality in the case of decoding is realizable is acquired.

0069 According to the video coding equipment concerning the invention of an application concerned according to claim 5, in the video coding equipment according to claim 1 said time direction change degree calculating means, Since said degree of time direction change was computed using the information on a motion vector and the information on coding mode which are acquired at the time of coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired.

0070 According to the video coding equipment concerning the invention of an application concerned according to claim 6. In the video coding equipment which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The image evaluation value calculating means which computes the image evaluation value to the decoded image of said dynamic image signal, Since it had the quantization width control means which controls the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value, The advantageous effect that the video coding equipment which can equalize image quality in the case of decoding is realizable is acquired by computing the image evaluation value of the local decoding image of a dynamic image signal, and carrying out feedback control of the quantization width of each picture according to this image evaluation value.

0071 According to the video coding equipment concerning the invention of an application concerned according to claim 7, in the video coding equipment according to claim 6 said image evaluation value calculating means, Since said image evaluation value was computed using the difference quantity between images of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.

0072 According to the video coding equipment concerning the invention of an application concerned according to claim 8, in the video coding equipment according to claim 6 said image evaluation value calculating means, Since said image evaluation value was computed using the S/N ratio of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video coding equipment which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.

0073 According to the video encoding method concerning the invention of an application concerned according to claim 9. In the video encoding method which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The time direction change degree calculating process which computes the degree of change of the time direction in said dynamic image signal, Since it was made to include the quantization width control process of controlling the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change, The advantageous effect that the video encoding method which can equalize image quality in the case of decoding is realizable is acquired by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.

0074 According to the video encoding method concerning the invention of an application concerned according to claim 10, in the video encoding method according to claim 9 said quantization width control process, When said degree of time direction change is small, since it was made to make quantization width small relatively to forward prediction coding and bidirectional prediction coding, the quantization width of the formation of a screen inner code, When the degree of time direction change is small, by making quantization width of I picture small relatively, the advantageous effect that the video encoding method which can prevent the unevenness of the image quality generated I picture cycle in the case of decoding is realizable is acquired.

0075 According to the video encoding method concerning the invention of an application concerned according to claim 11, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the difference information between the pictures in the inputted dynamic image signal, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.

0076 According to the video encoding method concerning the invention of an application concerned according to claim 12, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the information on the code amount assigned before coding, and the generated code amount obtained after coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.

0077 According to the video encoding method concerning the invention of an application concerned according to claim 13, in the video encoding method according to claim 9 said time direction change degree calculating process, Since said degree of time direction change was computed using the information on a motion vector and the information on coding mode which are acquired at the time of coding, By controlling the quantization width of each picture according to this degree of time direction change, the advantageous effect that the video encoding method which raises the homogeneity of image quality in the case of decoding is realizable is acquired.

0078 According to the video encoding method concerning the invention of an application concerned according to claim 14. In the video encoding method which considers a dynamic image signal as an input, chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, The image evaluation value calculating process which computes the image evaluation value to the decoded image of said dynamic image signal, Since it was made to include the quantization width control process of controlling the quantization width of the formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value, The advantageous effect that the video encoding method which can equalize image quality in the case of decoding is realizable is acquired by computing the image evaluation value of the local decoding image of a dynamic image signal, and carrying out feedback control of the quantization width of each picture according to this image evaluation value.

0079 According to the video encoding method concerning the invention of an application concerned according to claim 15, in the video encoding method according to claim 14 said image evaluation value calculating process, Since said image evaluation value was computed using the difference quantity between images of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video encoding method which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.

0080 According to the video encoding method concerning the invention of an application concerned according to claim 16, in the video encoding method according to claim 14 said image evaluation value calculating process, Since said image evaluation value was computed using the S/N ratio of the inputted dynamic image signal and the decoded image obtained at the time of coding, The advantageous effect that the video encoding method which can raise the homogeneity of image quality in the case of decoding is realizable is acquired by computing the image evaluation value of a local decoding image, and controlling the quantization width of each picture according to this image evaluation value.

0081 Since the video encoding program which performs the video encoding method according to any one of claims 9 to 16 was recorded according to the recording medium concerning the invention of an application concerned according to claim 17, It is effective in the recording medium in which the encoding program which can equalize image quality was mentioned on the occasion of decoding being obtained by computing the degree of time direction change of a dynamic image signal, and controlling the quantization width of each picture according to this degree of time direction change.

0082 Since the stream coded by the video coding equipment according to any one of claims 1 to 8 was recorded according to the recording medium concerning the invention of an application concerned according to claim 18, It is effective in the recording medium in which the coding stream which can be decoded was mentioned

by uniform image quality on the occasion of decoding being obtained.
0083 According to the video decoding method concerning the invention of an application concerned according to claim 19. It is the method of decoding the stream coded by the video coding equipment according to any one of claims 1 to 8, Since it was made to decode using the decoding device which decodes the stream which considered the dynamic image signal as the input and was coded in said dynamic image signal by the video coding equipment which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded when decoding the above-mentioned stream, It is not necessary to use the special decoding device corresponding to the coding equipment which can equalize such decoding image quality. If it is a decoding device corresponding to the stream coded by the video coding equipment which chooses bidirectional the formation of a screen inner code, forward prediction coding, or prediction coding, and is coded, a dynamic image signal only, There is an effect that decoding of the coding stream which can be decoded can be performed by uniform image quality and that a video decoding method is acquired.

Problem(s) to be Solved by the Invention However, since the ratio of the quantization width in each picture is set always constant in the above-mentioned rate control, depending on a dynamic image signal, image quality may not become uniform.
0006 For example, in image sequences with a small time change of a dynamic image signal, since the quota code amount of I picture is insufficient, the image quality of I picture may worsen relatively compared with the image quality of P picture and B picture, and the badness of the image quality of I picture may be visually conspicuous.
0007 This invention was made in order to solve the problem of the above conventional things, and an object of this invention is to provide the video coding equipment which can equalize the image quality of each picture in coding of a dynamic image signal, a video encoding method, a recording medium, and a video decoding method.

Means for Solving the Problem In order to solve this SUBJECT, the invention of an application concerned according to claim 1, In video coding equipment which considers a dynamic image signal as an input, chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It has a time direction change degree calculating means which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.
0009 In the video coding equipment according to claim 1, the invention of an application concerned according to claim 2 is made to make quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding, when said degree of time direction change of said quantization width control means is small.
0010 In the video coding equipment according to claim 1, as for the invention of an application concerned according to claim 3, said time direction change degree calculating means computes said degree of time direction change using difference information between pictures in an inputted dynamic image signal.
0011 The invention of an application concerned according to claim 4 computes said degree of time direction change in the video coding equipment according to claim 1 using information on a code amount which assigned said time direction change degree calculating means before coding, and a generated code amount obtained after coding.
0012 The invention of an application concerned according to claim 5 computes said degree of time direction change in the video coding equipment according to claim 1 using information on a motion vector and information on coding mode that said time direction change degree calculating means is acquired at the time of coding.
0013 In video coding equipment which the invention of an application concerned according to claim 6 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It has an image evaluation value calculating means which computes an image evaluation value to a decoded image of said dynamic image signal, and a quantization width control means which controls quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.
0014 The invention of an application concerned according to claim 7 computes said image evaluation value in the video coding equipment according to claim 6 using a difference quantity between images of a decoded image in which said image evaluation value calculating means is acquired at the time of an inputted dynamic image signal and coding.
0015 The invention of an application concerned according to claim 8 computes said image evaluation value in the video coding equipment according to claim 6 using a S/N ratio of a decoded image in which said image evaluation value calculating means is acquired at the time of an inputted dynamic image signal and coding.
0016 In a video encoding method which the invention of an application concerned according to claim 9 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It is made to include a time direction change degree calculating process which computes the degree of change of a time direction in said dynamic image signal, and a quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said degree of time direction change.
0017 In the video encoding method according to claim 9, the invention of an application concerned according to claim 10 is made to make quantization width small for quantization width of formation of a screen inner code relatively to forward prediction coding and bidirectional prediction coding, when said degree of time direction change of said quantization width control process is small.
0018 In the video encoding method according to claim 9, as for the invention of an application concerned according to claim 11, said time direction change degree calculating process computes said degree of time direction change using difference information between pictures in an inputted dynamic image signal.
0019 The invention of an application concerned according to claim 12 computes said degree of time direction change in the video encoding method according to claim 9 using information on a code amount which assigned said time direction change degree calculating process before coding, and a generated code amount obtained after coding.
0020 The invention of an application concerned according to claim 13 computes said degree of time direction change in the video encoding method according to claim 9 using information on a motion vector and information on coding mode that said time direction change degree calculating process is acquired at the time of coding.
0021 In a video encoding method which the invention of an application concerned according to claim 14 considers a dynamic image signal as an input, and chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes said dynamic image signal, It is made to include an image evaluation value calculating process which computes an image evaluation value to a decoded image of said dynamic image signal, and a quantization width control process of controlling quantization width of formation of a screen inner code, forward prediction coding, and bidirectional prediction coding according to said image evaluation value.
0022 The invention of an application concerned according to claim 15 computes said image evaluation value in the video encoding method according to claim 14 using a difference quantity between images of a decoded image in which said image evaluation value calculating process is acquired at the time of an inputted dynamic image signal and coding.
0023 The invention of an application concerned according to claim 16 computes said image evaluation value in the video encoding method according to claim 14 using a S/N ratio of a decoded image in which said image evaluation value calculating process is acquired at the time of an inputted dynamic image signal and coding.
0024 The invention of an application concerned according to claim 17 records a video encoding program which performs the video encoding method according to any one of claims 9 to 16.
0025 The invention of an application concerned according to claim 18 records a stream coded by the video coding equipment according to any one of claims 1 to 8.
0026 The invention of an application concerned according to claim 19 is the method of decoding a stream coded by the video coding equipment according to any one of claims 1 to 8, When decoding the above-mentioned stream, a dynamic image signal is considered as an input and it is made to decode using a decoding device which decodes a stream coded in said dynamic image signal by video coding equipment which chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and is coded.
0027
Embodiment of the Invention Hereafter, an embodiment of the invention is described using Drawings.
0028(Embodiment 1) Drawing 1 shows an example of the embodiment of the video coding equipment in the invention of an application concerned according to any one of claims 1 to 4. This video coding equipment performs quantization width control by performing the video encoding method in the invention of an application concerned according to any one of claims 9 to 12.
0029 In drawing 1, the inputted dynamic image signal is stored in the memory 11 for picture storing. The image data stored in the memory 11 is held after being rearranged into an order of performing coding until it is coded. For example, if the kind of picture is specified like drawing 3 to the picture stored in the memory 11, an order to code will serve as the I picture I1, the P picture P4, B picture B-2, the B picture B3, the P picture P7, B picture B5, and B picture B6.
0030 In drawing 3, the I picture I1 is formed into a screen inner code, the P picture P4 uses the I picture I1 as an image comparison, forward prediction coding is carried out, and bidirectional prediction coding of both B picture B-2 and B3 is carried out by using the I picture I1 and the P picture P4 as an image comparison. Furthermore, forward prediction coding is carried out by using the P picture P4 as an image comparison, both B picture B5 and B6 use the P pictures P4 and P7 as an image comparison, and bidirectional prediction coding of the P picture P7 is carried out. On the other hand, the difference information between the pictures acquired

from the image data of the memory 11 is sent to the time direction change degree calculation part 14, and is used as information for computing the degree of time direction change of a dynamic image signal.

0031 The coding part 12 codes the image data memorized by the memory 11 with the quantization width given from the quantization width control section 18, and outputs a compression code sequence to the buffer 13. The time direction change degree calculation part 14 computes the degree of time direction change of a dynamic image signal based on the difference information between the pictures acquired from the image data of the memory 11, and the information on the generated code amount in the buffer 13. The quantization width control section 18 comprises the quantization width coefficient deciding part 15, the GOP quantization width deciding part 16, and the picture quantization width deciding part 17. The quantization width coefficient deciding part 15 responds to the degree of time direction change of the dynamic image signal computed by the time direction change degree calculation part 14, and is a quantization width coefficient () of each picture. **Ki and** Determine Kp and Kb and the GOP quantization width deciding part 16, Determining the basis child-ized width in GOP based on transition of the generated code amount in a predetermined encoding rate and the buffer 13, the picture quantization width deciding part 17 determines the quantization width of the picture made into a coding subject from the basis child-ized width of GOP, and the quantization width coefficient of each picture.

0032 The case where image sequences with the small degree of time direction change are hereafter coded by the encoding order of drawing 3 is explained. In the encoding order of drawing 3, the inputted picture is coded in order of the I picture I1, the P picture P4, B picture B-2, and the B picture B3. Here, supposing distribution of the code amount assigned to each picture is unsuitable and sufficient code amount for the I picture I1 is not assigned, the quantization width of the I picture I1 becomes large, and sufficient image quality will be obtained in the I picture I1. On the other hand, since the prediction error signal after motion compensation prediction is also small when the degree of time direction change is small, it can quantize finely enough, and the P picture P4 which uses the I picture I1 as an image comparison can obtain the image quality near **picture / I1 / I** an inputted image. As for B picture B-2 and the B picture B3, the prediction error signal after motion compensation prediction becomes small similarly, and image quality equivalent to the P picture P4 is obtained. As a result, in the above-mentioned decoded image, the bad image of image quality will appear with the cycle of I picture, and the unevenness of image quality will be visually conspicuous.

0033 Then, it considers enlarging relatively the code amount assigned to the I picture I1. The I picture I1 serves as image quality near an inputted image compared with the case where quantization width becomes small and only the part whose quota code amount increased is ****. Since the image quality of the I picture I1 used as an image comparison improves about the P picture P4, the prediction error signal after motion compensation prediction becomes still smaller, and where equivalent image quality is maintained, it can reduce a generated code amount. About B picture B-2 and B3, the prediction error signal after motion compensation prediction becomes small similarly, and image quality equivalent to the P picture P4 is obtained.

0034 The generated code amount at the time of amending a generated code amount when the quota code amount of the I picture I1 is not enough so that the quota code amount of the I picture I1 may be increased more than drawing 4 (a) in drawing 4 (b) again is shown in drawing 4 (a). In drawing 4, although the generated code amount of the I picture I1 has more drawing 4 (b), the direction of the generated code amount of the P picture P4 of drawing 4 (b) which uses the good I picture I1 of image quality as an image comparison has decreased. In the case of both, the total generated code amount at this time is almost the same.

0035 The S/N ratio in the case of both is shown in drawing 5. Since drawing 5 (a) of the quota code amount of the I picture I1 is insufficient, the S/N ratio is getting worse compared with other pictures, but in drawing 5 (b), the S/N ratio of the I picture I1 is improved, and it turns out that image quality is almost uniform.

0036 The example of the method of computing the degree of time direction change to below by the time direction change degree calculation part 14, and determining the quantization width coefficient Ki of I picture as it by the quantization width coefficient deciding part 15 is shown. In this method, the difference information between the pictures in a dynamic image signal and the information on the generated code amount obtained after coding are used.

0037 First, in the time direction change degree calculation part 14, it asks for image data F1 of the memory 11, and the difference D between the pictures in F2 by (several 1), and the degree Z1 of time direction change is computed by (several 2) from this result.

0038

Equation 1

For drawings please refer to the original document.

Equation 2

For drawings please refer to the original document.

However, F1 (x, y) and F2 (x, y) are the difference values of picture F1 in coordinates (x, y), the picture element data (it is usually luminance data) of F2, the pixel number from which Npixel constitutes the picture of one sheet, and the maximum which can be regarded as the degree of time direction change of Dt being small. For example, it will be referred to as Dt=5, if it supposes that the degree of time direction change is small when it is five or less difference in the difference value of a luminance level. Therefore, picture F1 and the difference D of F2 are set to 0 <=Z1<1 when smaller than Dt, and they can judge that the degree of time direction change is small.

0039 Next, the degree Z2 of time direction change is calculated from (several 3) and (several 4) based on the generated code amount Spbb and the GOP quota code amount Tgop which are measured with the buffer 13.

Equation 3

For drawings please refer to the original document.

Equation 4

For drawings please refer to the original document.

However, Spbb is the sum of a set of three new generated code amounts in time among the components (P picture / B picture / B picture should put together by encoding order) of one P picture and two B pictures. Cp and Cb express the anticipation generated code amount of P picture when the anticipation generated code amount of I picture is set to 1, and B picture, respectively, for example, set up a value like Cp=0.5 and Cb=0.25. Tpbb is an anticipation quota code amount distributed to one P picture and two B pictures, and is calculated using the anticipation generated code amount ratios Cp and Cb of P picture and B picture defined by the GOP quota code amount Tgop and the above. Therefore, when there are few generated code amounts of one P picture and two B pictures than an anticipation quota code amount, it is set to 0 <=Z2<1, and it can be judged that the degree of time direction change is small.

0040 In the quantization width coefficient deciding part 15, (several 5) determines the quantization width coefficient Ki of I picture using the degrees Z1 and Z2 of time direction change for which it asked by (several 2) and (several 4).

Equation 5

For drawings please refer to the original document.

However, "=" in (several 5) means substitution. w1 and w2 are the weighting factors to the degrees Z1 and Z2 of time direction change, respectively, for example, they are defined like 0 <=w1+w2 <=0.2. It may be for defining the upper limit of w1+w2 preventing superfluous amendment of quantization width here, and this value may not be 0.2.

0041 The image quality of I picture can be brought close to the image quality of P picture and B picture by amending the quantization width coefficient Ki and adjusting the quantization width of I picture with the above method.

0042 Namely, the quantization width coefficient deciding part 15 determines the quantization width coefficient of each picture type from the above-mentioned degree of time direction change, From transition of the generated code amount in a predetermined encoding rate and the buffer 13, the GOP quantization width deciding part 16 determines the basis child-ized width of GOP, and by the picture quantization width deciding part 17. When the quantization width of the picture made into a coding subject from the basis child-ized width of these GOP and the quantization width coefficient of each picture is determined and the coding part 12 codes with the quantization width given from the quantization width control section 18, The image quality of I picture can be brought close to the image quality of P picture and B picture.

0043 Although Ki was amended and quantization width of I picture was adjusted by an above-mentioned method, Kp and Kb may be amended and quantization width of P picture or B picture may be adjusted.

0044 Thus, according to this Embodiment 1, image quality of I picture, P picture, and B picture can be made uniform by controlling quantization width of each picture according to the degree of time direction change of a dynamic image signal. In a dynamic image signal especially with the small degree of time direction change, degradation of image quality produced with a cycle of I picture can be prevented.

0045 Although difference information between pictures of a dynamic image signal and information on a generated code amount obtained after coding were used as information for computing the degree of change of a time direction in this embodiment, For example, like information on a motion vector obtained at the time of coding, or information on coding mode (it corresponds to Claim 5 and 13), as long as it is information with the degree of time direction change of a dynamic image

signal, and correlation, what kind of information may be used. The example is indicated to be (several 6) to (several 7).
0046
Equation 6

For drawings please refer to the original document.

Equation 7

For drawings please refer to the original document.

However, MV (i, j) is a macro block number from which a motion vector of each macro block, and Rx and Ry constitute a search range of a motion vector, MD (i, j) constitutes coding mode (if it is intra coding and is 1 and inter encoding 0) of each macro block, and Nmb constitutes a picture. The degree Z1 of time direction change calculated by (several 6) is the value which normalized average size of a motion vector in a picture made into a coding subject in the range of 0 to 1, and it can be said that change of image sequences is small, so that Z1 is **zero** near. It can be said that it expresses a rate of intra coding of a picture made into a coding subject, its a possibility that motion prediction will come true is so high that Z2 is **zero** near as for the degree Z2 of time direction change calculated by (several 7), and its change of image sequences is small.
0047 The quantization width Ki of I picture can be amended by applying Z1 and Z2 which were obtained by (several 6) and (several 7) to (several 5). Thus, average size and a rate of intra coding of a motion vector can also be used as one measure of the degree of time direction change.
0048(Embodiment 2) Drawing 2 shows an example of an embodiment of video coding equipment in the invention according to claim 6 or 7. This video coding equipment performs quantization width control by performing a video encoding method in the invention of an application concerned according to claim 14 or 15.
0049 In drawing 2, the memory 21, the coding part 22, and the buffer 23 have the respectively same function as the memory 11 of drawing 1, the coding part 12, and the buffer 13. The image evaluation value calculation part 24 computes an image evaluation value in a decoded image of each picture from inputted image data stored in the memory 21, and local decoding image data generated in the coding part 22. The quantization width control section 28 comprises the quantization width coefficient deciding part 25, the GOP quantization width deciding part 26, and the picture quantization width deciding part 27, Among these, the GOP quantization width deciding part 26 and the picture quantization width deciding part 27 have the respectively same function as the GOP quantization width deciding part 16 of drawing 1, and the picture quantization width deciding part 17. The quantization width coefficient deciding part 25 determines a quantization width coefficient (Ki, Kp, Kb) to each picture so that image quality of each picture may become uniform based on an image evaluation value computed by the image evaluation value calculation part 24.
0050 An example of a method of computing an image evaluation value to below by the image evaluation value calculation part 24, and determining a quantization width coefficient of each picture as it by the quantization width coefficient deciding part 25 is shown. In this method, a difference quantity between images of an inputted image and a decoded image (error) is used as an image evaluation value.
0051 First, in the image evaluation value calculation part 24, the error E in the inputted image Fin and the decoded image Fdec is searched for by (several 8) from each picture of a just before GOP, and then the average error Ec of each picture type (I, P, B) and the average error Egop in the whole GOP are calculated by (several 9) and (several 10).
0052
Equation 8

For drawings please refer to the original document.

Equation 9

For drawings please refer to the original document.

Equation 10

For drawings please refer to the original document.

However, the number of pictures of each picture type and Ngop of the pixel number and Nc from which Npixel constitutes a picture are the numbers of pictures of GOP.
0053 Next, in the quantization width coefficient deciding part 25, the average error Ec of each picture type is compared with the average error Egop in the whole GOP. If the average error Ei of I picture is larger than the average error Egop of GOP, image quality of I picture will judge relatively that it is bad, and the quantization width coefficient Ki of I picture will be amended so that it may become small. Amendment with the same said of P picture and B picture is performed. (Several 11) and (several 12) perform amendment of a quantization width coefficient in each picture type.
0054
Equation 11

For drawings please refer to the original document.

Equation 12

For drawings please refer to the original document.

However, "=" in (several 12) means substitution. A threshold for Et to normalize an image evaluation value in the range of -1 to 1 and Zc are the weighting factors of an image evaluation value, for example, define the image evaluation value of each picture type, and w like 0<=w<=0.2. It may be for defining the upper limit of w preventing superfluous amendment of quantization width here, and this value may not be 0.2.
0055 Image quality of I picture can be brought close to image quality of P picture and B picture by amending the quantization width coefficient Ki and adjusting quantization width of I picture with the above method. It is the same also about P picture and B picture.
0056 Namely, the quantization width coefficient deciding part 25 determines a quantization width coefficient of I picture from an average error of I picture, and an average error in the whole GOP, From transition of a generated code amount in a predetermined encoding rate and the buffer 13, the GOP quantization width deciding part 26 determines basis child-ized width of GOP, and by the picture quantization width deciding part 27. When quantization width of a picture made into a coding subject from basis child-ized width of these GOP and a quantization width coefficient of I picture is determined and the coding part 22 codes with quantization width given from the quantization width control section 28, Image quality of I picture can be brought close to image quality of P picture and B picture. It is the same also about P picture and B picture.
0057 Thus, by according to this Embodiment 2, computing an image evaluation value in a decoded image of a coded dynamic image signal, and carrying out the direct valuation of the image quality about each of I picture, P picture, and B picture, Feedback control which enables coding which becomes uniform **image quality of each picture** becomes possible.
0058 In this Embodiment 2, although process delay and memory space are reducible by performing calculation processing with error to an inputted image and a decoded image by a macro block unit, a frame unit or GOP units may be sufficient as calculation processing with error.
0059 In this Embodiment 2, although image evaluation of a decoded image is performed by making GOP into a unit, the unit in particular of image evaluation may not be GOP. As long as it is the information which can evaluate image quality of a decoded image also about information used for image evaluation, for example like a S/N ratio (it corresponds to Claim 8 and 16) only in a difference quantity between images of an inputted image and a decoded image, what kind of information may be sufficient.
0060 In above Embodiments 1 and 2, although it was the GOP structure (M is an insertion interval of I picture or P picture, and N is the number of pictures of GOP) of M= 3 and N= 15, and a case where picture structure was the frame structure was mentioned as an example and explained, a different value may be sufficient as M and N. The frame structure or field structure may be sufficient as picture structure of each picture.
0061 This invention can be carried out as coding equipment on a computer system by a program's realizing and recording this on a recording medium (it corresponds to Claim 17).
0062 As shown in drawing 6, a recording medium which recorded a coding stream which can be decoded by uniform image quality is obtained by recording a stream

coded in the above-mentioned coding equipment 100 on the recording medium 200 (it corresponds to Claim 18).
0063 In reproducing a stream which once recorded this stream itself or this that was coded on a recording medium, and was reproduced, It is possible not to need a device special as the decoding device 300, but to reproduce this with a decoding device corresponding to conventional coding equipment and same decoding device, and it is possible to perform the decoding by uniform image quality moreover (it corresponds to Claim 19).
0064 In order that the Reason may equalize assignment of a code amount under a premise that coding by this invention chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding, and codes, It is because a decoding device only chooses bidirectional formation of a screen inner code, forward prediction coding, or prediction coding and should just support a coding mode.

Brief Description of the Drawings
Drawing 1 The block diagram showing the composition of the video encoding method in the embodiment of the invention 1
Drawing 2 The block diagram showing the composition of the video encoding method in the embodiment of the invention 2
Drawing 3 The figure showing the picture used as an image comparison when carrying out prediction coding of each picture
Drawing 4 The figure showing the generated code amount of each picture in the embodiment of the invention 1 and the conventional method
Drawing 5 The figure showing the S/N ratio of each picture in the embodiment of the invention 1 and the conventional method
Drawing 6 The figure showing the embodiment which combined this invention with the recording medium and the decoding device
Description of Notations
11 and 21 Memory for inputted image storing
12 and 22 Coding part
13 and 23 Buffer for a compression code sequence output
14 Time direction change degree calculation part
24 Image evaluation value calculation part
15 and 25 Quantization width coefficient deciding part
16, 26 GOP quantization width deciding part
17 and 27 Picture quantization width deciding part
18 and 28 Quantization width control section

Drawing 1

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

Drawing 6

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

For drawings please refer to the original document.

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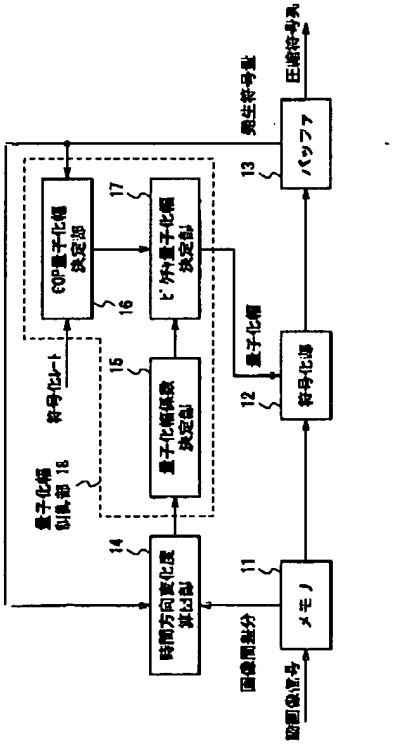
(54)【発明の名称】　動画像符号化装置、動画像符号化方法、記録媒体、および動画像復号方法

(57)【要約】
【課題】　ＩピクチャとＰピクチャとＢピクチャを組み合わせた動画像符号化において、各ピクチャの画質を均一に保つことを目的とする。
【解決手段】　時間方向変化度算出部１４は、メモリ１１の入力画像データとバッファ１３の発生符号量の情報を基に動画像信号の時間方向変化度を算出する。量子化幅制御部１８は、量子化幅係数算出部１５とＧＯＰ量子化幅決定部１６とピクチャ量子化幅決定部１７から構成され、所定の符号化レートとバッファ１３における発生符号量の推移から求めたＧＯＰの基準量子化幅と、上記の時間方向変化度から算出した各ピクチャタイプの量子化幅係数を用いて、符号化対象とするピクチャの量子化幅を決定する。



【特許請求の範囲】

【請求項１】 動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、

前記動画像信号における時間方向の変化度を算出する時間方向変化度算出手段と、

前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御手段とを備えたことを特徴とする動画像符号化装置。

【請求項２】 請求項１記載の動画像符号化装置において、

前記量子化幅制御手段は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくすることを特徴とする動画像符号化装置。

【請求項３】 請求項１記載の動画像符号化装置において、

前記時間方向変化度算出手段は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化装置。

【請求項４】 請求項１記載の動画像符号化装置において、

前記時間方向変化度算出手段は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化装置。

【請求項５】 請求項１記載の動画像符号化装置において、

前記時間方向変化度算出手段は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化装置。

【請求項６】 動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、

前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出手段と、

前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御手段とを備えたことを特徴とする動画像符号化装置。

【請求項７】 請求項６記載の動画像符号化装置において、

前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記画質評価値を算出することを特徴とする動画像符号化装置。

【請求項８】 請求項６記載の動画像符号化装置において、

前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像のＳ／Ｎ比を用いて前記画質評価値を算出することを特徴とする動画像符号化装置。

【請求項９】 動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、

前記動画像信号における時間方向の変化度を算出する時間方向変化度算出工程と、

前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むことを特徴とする動画像符号化方法。

【請求項１０】 請求項９記載の動画像符号化方法において、

前記量子化幅制御工程は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくすることを特徴とする動画像符号化方法。

【請求項１１】 請求項９記載の動画像符号化方法において、

前記時間方向変化度算出工程は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化方法。

【請求項１２】 請求項９記載の動画像符号化方法において、

前記時間方向変化度算出工程は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化方法。

【請求項１３】 請求項９記載の動画像符号化方法において、

前記時間方向変化度算出工程は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出することを特徴とする動画像符号化方法。

【請求項１４】 動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、

前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出工程と、

前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むことを特徴とする動画像符号化方法。

【請求項１５】 請求項１４記載の動画像符号化方法において、

前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記

画質評価値を算出することを特徴とする動画像符号化方法。
【請求項16】 請求項14記載の動画像符号化方法において、
前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像のS／N比を用いて前記画質評価値を算出することを特徴とする動画像符号化方法。
【請求項17】 請求項9ないし16のいずれかに記載の動画像符号化方法を実行させる動画像符号化プログラムを記録したことを特徴とする記録媒体。
【請求項18】 請求項1ないし8のいずれかに記載の動画像符号化装置により符号化されたストリームを記録したことを特徴とする記録媒体。
【請求項19】 請求項1ないし8のいずれかに記載の動画像符号化装置により符号化されたストリームを復号する方法であって、
上記ストリームを復号する際、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置により符号化されたストリームを復号する復号装置を用いて復号を行うことを特徴とする動画像復号方法。
【発明の詳細な説明】
【0001】
【発明の属する技術分野】本発明は、動画像符号化装置、動画像符号化方法、記録媒体、および動画像復号方法に関し、特に、動画像データを高能率に圧縮する動画像符号化装置の改良を図ったものに関する。
【0002】
【従来の技術】動画像データを高能率に圧縮する符号化技術として、例えばMPEG2のように、画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法が知られている。
【0003】このような動画像符号化方法においては、画面内符号化した画面（以下、Iピクチャと称す）と、前方向予測符号化した画面（以下、Pピクチャと称す）と、双方向予測符号化した画面（以下、Bピクチャと称す）とが混在しているため、高能率な符号化を実現するためには符号化対象とするピクチャの種類に応じて適切に符号量を割当てるようなレート制御が必要となる。
【0004】MPEG2のTM5(Test Model 5)で採用されているレート制御ではIピクチャとPピクチャとBピクチャの量子化幅の比率を
Ki：Kp：Kb＝1：1：1．4
と規定し、上記の量子化幅の比率を基にGOP(Group of Pictures)の割当て符号量から各ピクチャの割当て符号量を算出している。
【0005】
【発明が解決しようとする課題】しかしながら、上記のレート制御においては各ピクチャにおける量子化幅の比率を常に一定としているため、動画像信号によっては画質が均一とならない場合がある。
【0006】例えば、動画像信号の時間的な変化が小さい画像系列においては、Iピクチャの割当て符号量が不十分なためにIピクチャの画質がPピクチャとBピクチャの画質に比べて相対的に悪くなり、Iピクチャの画質の悪さが視覚的に目立つことがある。
【0007】本発明は、上記のような従来のものの問題点を解決するためになされたもので、動画像信号の符号化において各ピクチャの画質を均一化することが可能な動画像符号化装置、動画像符号化方法、記録媒体、および動画像復号方法を提供することを目的としている。
【0008】
【課題を解決するための手段】この課題を解決するために、本願の請求項1記載の発明は、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、前記動画像信号における時間方向の変化度を算出する時間方向変化度算出手段と、前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御手段とを備えるようにしたものである。
【0009】また、本願の請求項2記載の発明は、請求項1記載の動画像符号化装置において、前記量子化幅制御手段は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくするようにしたものである。
【0010】また、本願の請求項3記載の発明は、請求項1記載の動画像符号化装置において、前記時間方向変化度算出手段は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出するようにしたものである。
【0011】また、本願の請求項4記載の発明は、請求項1記載の動画像符号化装置において、前記時間方向変化度算出手段は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出するようにしたものである。
【0012】また、本願の請求項5記載の発明は、請求項1記載の動画像符号化装置において、前記時間方向変化度算出手段は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出するようにしたものである。
【0013】また、本願の請求項6記載の発明は、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出手段と、前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御

する量子化幅制御手段とを備えるようにしたものである。

【００１４】また、本願の請求項７記載の発明は、請求項６記載の動画像符号化装置において、前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記画質評価値を算出するようにしたものである。

【００１５】また、本願の請求項８記載の発明は、請求項６記載の動画像符号化装置において、前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像のＳ／Ｎ比を用いて前記画質評価値を算出するようにしたものである。

【００１６】また、本願の請求項９記載の発明は、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、前記動画像信号における時間方向の変化度を算出する時間方向変化度算出工程と、前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むようにしたものである。

【００１７】また、本願の請求項１０記載の発明は、請求項９記載の動画像符号化方法において、前記量子化幅制御工程は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくするようにしたものである。

【００１８】また、本願の請求項１１記載の発明は、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出するようにしたものである。

【００１９】また、本願の請求項１２記載の発明は、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出するようにしたものである。

【００２０】また、本願の請求項１３記載の発明は、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出するようにしたものである。

【００２１】また、本願の請求項１４記載の発明は、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出工程と、前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むようにしたものである。

【００２２】また、本願の請求項１５記載の発明は、請求項１４記載の動画像符号化方法において、前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記画質評価値を算出するようにしたものである。

【００２３】また、本願の請求項１６記載の発明は、請求項１４記載の動画像符号化方法において、前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像のＳ／Ｎ比を用いて前記画質評価値を算出するようにしたものである。

【００２４】また、本願の請求項１７記載の発明は、請求項９ないし１６のいずれかに記載の動画像符号化方法を実行させる動画像符号化プログラムを記録するようにしたものである。

【００２５】また、本願の請求項１８記載の発明は、請求項１ないし８のいずれかに記載の動画像符号化装置により符号化されたストリームを記録するようにしたものである。

【００２６】また、本願の請求項１９記載の発明は、請求項１ないし８のいずれかに記載の動画像符号化装置により符号化されたストリームを復号する方法であって、上記ストリームを復号する際、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置により符号化されたストリームを復号する復号装置を用いて復号を行うようにしたものである。

【００２７】

【発明の実施の形態】以下、本発明の実施の形態について、図面を用いて説明する。

【００２８】（実施の形態１）図１は本願の請求項１ないし４のいずれかに記載の発明における動画像符号化装置の実施の形態の一例を示している。この動画像符号化装置は、本願の請求項９ないし１２のいずれかに記載の発明における動画像符号化方法を実行することにより、量子化幅制御を行うものである。

【００２９】図１において、入力された動画像信号は画像格納用のメモリ１１に蓄えられる。メモリ１１に蓄えられた画像データは符号化を実行する順序に並び替えられた後、符号化されるまで保持される。例えばメモリ１１に蓄えられる画像に対して、図３のようにピクチャの種類を指定すると、符号化する順序はＩピクチャＩ１、ＰピクチャＰ４、ＢピクチャＢ２、ＢピクチャＢ３、ＰピクチャＰ７、ＢピクチャＢ５、ＢピクチャＢ６となる。

【００３０】図３において、ＩピクチャＩ１は画面内符号化され、ＰピクチャＰ４はＩピクチャＩ１を参照画像として前方向予測符号化され、ＢピクチャＢ２とＢ３はともにＩピクチャＩ１とＰピクチャＰ４を参照画像として双方向予測符号化される。さらにＰピクチャＰ７はＰ

ピクチャＰ４を参照画像として前方向予測符号化され、ＢピクチャＢ５とＢ６はともにＰピクチャＰ４とＰ７を参照画像として双方向予測符号化される。一方、メモリ１１の画像データから得られる画像間の差分情報は時間方向変化度算出部１４に送られ、動画像信号の時間方向変化度を算出するための情報として用いられる。

【００３１】符号化部１２は、量子化幅制御部１８から与えられる量子化幅でメモリ１１に記憶されている画像データを符号化し、バッファ１３に圧縮符号列を出力する。時間方向変化度算出部１４は、メモリ１１の画像データから得られる画像間の差分情報と、バッファ１３における発生符号量の情報を基に動画像信号の時間方向変化度を算出する。量子化幅制御部１８は、量子化幅係数決定部１５とＧＯＰ量子化幅決定部１６とピクチャ量子化幅決定部１７とから構成される。量子化幅係数決定部１５は、時間方向変化度算出部１４で算出された動画像信号の時間方向変化度に応じて各ピクチャの量子化幅係数（Ｋｉ、Ｋｐ、Ｋｂ）を決定し、ＧＯＰ量子化幅決定部１６は、所定の符号化レートとバッファ１３における発生符号量の推移を基にＧＯＰにおける基準量子化幅を決定し、ピクチャ量子化幅決定部１７は、ＧＯＰの基準量子化幅と各ピクチャの量子化幅係数から符号化対象とするピクチャの量子化幅を決定する。

【００３２】以下、時間方向変化度の小さい画像系列を図３の符号化順で符号化する場合について説明する。図３の符号化順では、入力された画像はＩピクチャＩ１、ＰピクチャＰ４、ＢピクチャＢ２、ＢピクチャＢ３の順で符号化される。ここで、もし各ピクチャに割当てる符号量の配分が不適切で、ＩピクチャＩ１に十分な符号量が割当てられなかったとすると、ＩピクチャＩ１の量子化幅が大きくなってＩピクチャＩ１において十分な画質が得られないことになる。一方、ＩピクチャＩ１を参照画像とするＰピクチャＰ４は、時間方向変化度が小さいときには動き補償予測後の予測誤差信号も小さいので十分細かく量子化することができ、ＩピクチャＩ１よりも入力画像に近い画質を得ることができる。さらに、ＢピクチャＢ２とＢピクチャＢ３も同様に動き補償予測後の予測誤差信号が小さくなり、ＰピクチャＰ４と同等の画質が得られる。この結果、上記の復号画像においてＩピクチャの周期で画質の悪い画像が現れることになり、視覚的に画質の不均一さが目立ってしまう。

【００３３】そこで、ＩピクチャＩ１に割当てる符号量を相対的に大きくすることを考える。ＩピクチャＩ１は割当て符号量が増えた分だけ量子化幅が小さくなり、上述の場合に比べて入力画像に近い画質となる。ＰピクチャＰ４に関しては、参照画像とするＩピクチャＩ１の画質が向上するので、動き補償予測後の予測誤差信号はさらに小さくなり、同等の画質を保った状態で発生符号量を削減することができる。ＢピクチャＢ２とＢ３については、同様に動き補償予測後の予測誤差信号が小さくなりＰピクチャＰ４と同等の画質が得られる。

【００３４】図４（ａ）にＩピクチャＩ１の割当て符号量が十分でない場合の発生符号量を、また図４（ｂ）にＩピクチャＩ１の割当て符号量を図４（ａ）よりも多くなるように補正した場合の発生符号量を示す。図４において、ＩピクチャＩ１の発生符号量は図４（ｂ）の方が多いが、ＰピクチャＰ４の発生符号量は画質の良いＩピクチャＩ１を参照画像とする図４（ｂ）の方が少なくなっている。また、このときの総発生符号量は両者の場合においてほぼ同一である。

【００３５】図５に両者の場合におけるＳ／Ｎ比を示す。図５（ａ）ではＩピクチャＩ１の割当て符号量が不十分なためにＳ／Ｎ比が他のピクチャに比べて悪くなっているが、図５（ｂ）ではＩピクチャＩ１のＳ／Ｎ比が改善されて画質がほぼ均一となっていることが分かる。

【００３６】以下に、時間方向変化度算出部１４で時間方向変化度を算出し、量子化幅係数決定部１５でＩピクチャの量子化幅係数Ｋｉを決定する方法の例を示す。この方法では、動画像信号における画像間の差分情報と符号化後に得られる発生符号量の情報を用いている。

【００３７】まず、時間方向変化度算出部１４において、メモリ１１の画像データＦ１とＦ２における画像間の差分Ｄを（数１）で求め、この結果から時間方向変化度Ｚ１を（数２）により算出する。

【００３８】

【数１】

$$D = \frac{\Sigma |F1(x,y) - F2(x,y)|}{Npixel}$$

【数２】

$$Z1 = \frac{\min(Dt, D)}{Dt}$$

ただし、Ｆ１（ｘ，ｙ）とＦ２（ｘ，ｙ）は座標（ｘ，ｙ）における画像Ｆ１とＦ２の画素データ（通常、輝度データである）、Ｎｐｉｘｅｌは１枚のピクチャを構成する画素数、Ｄｔは時間方向変化度が小さいとみなすことができる上限の差分値である。例えば、輝度レベルの差分値で５以下の差であるときに時間方向変化度が小さいとするのであれば、Ｄｔ＝５とする。従って、画像Ｆ１とＦ２の差分ＤがＤｔよりも小さい場合は０≦Ｚ１＜１となり、時間方向変化度が小さいと判断できる。

【００３９】次に、バッファ１３で測定される発生符号量ＳｐｂｂとＧＯＰ割当て符号量Ｔｇｏｐを基に（数３）と（数４）から時間方向変化度Ｚ２を計算する。

【数３】

$$Tpbb = \frac{Cp + 2 \cdot Cb}{1 + 4 \cdot Cp + 10 \cdot Cb} \cdot Tgop$$

【数４】

$$Z2 = \frac{\min(Tpbb, Spbb)}{Tpbb}$$

ただし、ＳｐｂｂはＰピクチャ１枚とＢピクチャ２枚の

構成要素（符号化順でPピクチャ／Bピクチャ／Bピクチャの組み合わせ）のうち最も時間的に新しい3枚組の発生符号量の和である。CpとCbはそれぞれIピクチャの予想発生符号量を1としたときのPピクチャとBピクチャの予想発生符号量を表し、例えばCp＝0．5、Cb＝0．25のような値を設定する。TpbbはPピクチャ1枚とBピクチャ2枚に配分される予想割当て符号量であり、GOP割当て符号量Tgopと上記で定めたPピクチャとBピクチャの予想発生符号量比CpとCbを用いて計算される。従って、Pピクチャ1枚とBピクチャ2枚の発生符号量が予想割当て符号量より少ない場合は0≦Z2＜1となり、時間方向変化度が小さいと判断できる。

【0040】さらに、量子化幅係数決定部15において、（数2）と（数4）で求めた時間方向変化度Z1とZ2を用いて、Iピクチャの量子化幅係数Kiを（数5）により決定する。

【数5】

$$Ki = \{1-w1\cdot(1-Z1)-w2\cdot(1-Z2)\}\cdot Ki$$

ただし、（数5）における“＝”は代入を意味する。また、w1とw2はそれぞれ、時間方向変化度Z1とZ2に対する重み係数であり、例えば0≦w1＋w2≦0．2のように定める。ここで、w1＋w2の上限値を定めるのは量子化幅の過剰な補正を防ぐためであり、この値は0．2でなくてもかまわない。

【0041】以上の方法により、量子化幅係数Kiを補正し、Iピクチャの量子化幅を調整することによって、Iピクチャの画質をPピクチャとBピクチャの画質に近づけることができる。

【0042】即ち、量子化幅係数決定部15により上記の時間方向変化度から各ピクチャタイプの量子化幅係数を決定し、GOP量子化幅決定部16により所定の符号化レートとバッファ13における発生符号量の推移からGOPの基準量子化幅を決定し、ピクチャ量子化幅決定部17により、これらGOPの基準量子化幅と各ピクチャの量子化幅係数から符号化対象とするピクチャの量子化幅を決定し、量子化幅制御部18から与えられる量子化幅により符号化部12が符号化を行うことにより、Iピクチャの画質をPピクチャとBピクチャの画質に近づけることができる。

【0043】また、上記の方法ではKiを補正してIピクチャの量子化幅を調整したが、KpとKbを補正してPピクチャまたはBピクチャの量子化幅を調整してもかまわない。

【0044】このように、本実施の形態1によれば、動画像信号の時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、IピクチャとPピクチャとBピクチャの画質を均一とすることができる。特に時間方向変化度の小さい動画像信号においては、Iピクチャの周期で生じる画質の劣化を防ぐことができる。

【0045】なお、本実施の形態においては、時間方向の変化度を算出するための情報として、動画像信号の画像間差分情報と符号化後に得られる発生符号量の情報を用いたが、例えば符号化時に得られる動きベクトルの情報や符号化モードの情報（請求項5，13に対応）のように、動画像信号の時間方向変化度と相関のある情報であればどのような情報を用いてもよい。その一例を（数6）と（数7）に示す。

【0046】

【数6】

$$Z1 = \frac{\Sigma|MV(i,j)|}{Nmb}\cdot\frac{1}{\sqrt{Rx^2+Ry^2}}$$

【数7】

$$Z2 = \frac{\Sigma MD(i,j)}{Nmb}$$

ただし、MV（i，j）は各マクロブロックの動きベクトル、RxとRyは動きベクトルの探索範囲、MD（i，j）は各マクロブロックの符号化モード（イントラ符号化なら1、インター符号化なら0）、Nmbはピクチャを構成するマクロブロック数である。（数6）で計算される時間方向変化度Z1は、符号化対象とするピクチャにおける動きベクトルの平均サイズを0から1の範囲に正規化した値であり、Z1が0に近いほど画像系列の変化が小さいといえる。また、（数7）で計算される時間方向変化度Z2は、符号化対象とするピクチャのイントラ符号化率を表し、Z2が0に近いほど動き予測が当たる可能性が高く、画像系列の変化が小さいといえる。

【0047】（数6）および（数7）で得られたZ1とZ2を（数5）に適用することにより、Iピクチャの量子化幅Kiを補正することができる。このように動きベクトルの平均サイズおよびイントラ符号化率も時間方向変化度の一つの尺度として用いることができる。

【0048】（実施の形態2）図2は請求項6または7に記載の発明における動画像符号化装置の実施の形態の一例を示している。この動画像符号化装置は、本願の請求項14または15に記載の発明における動画像符号化方法を実行することにより、量子化幅制御を行うものである。

【0049】図2において、メモリ21と符号化部22とバッファ23はそれぞれ図1のメモリ11と符号化部12とバッファ13と同じ機能をもつ。画質評価値算出部24は、メモリ21に蓄えられた入力画像データと符号化部22で生成される局所復号画像データから各ピクチャの復号画像における画質評価値を算出する。量子化幅制御部28は、量子化幅係数決定部25とGOP量子化幅決定部26とピクチャ量子化幅決定部27とから構成され、このうちGOP量子化幅決定部26，ピクチャ量子化幅決定部27はそれぞれ図1のGOP量子化幅決

定部１６，ピクチャ量子化幅決定部１７と同じ機能をもつ。量子化幅係数決定部２５は、画質評価値算出部２４で算出された画質評価値を基に各ピクチャの画質が均一となるように各ピクチャに対する量子化幅係数（Ｋｉ、Ｋｐ、Ｋｂ）を決定する。

【００５０】以下に、画質評価値算出部２４で画質評価値を算出し、量子化幅係数決定部２５で各ピクチャの量子化幅係数を決定する方法の例を示す。この方法では、画質評価値として入力画像と復号画像の画像間差分量（誤差）を用いている。

【００５１】まず、画質評価値算出部２４において、直前ＧＯＰの各ピクチャに対して入力画像Ｆｉｎと復号画像Ｆｄｅｃにおける誤差Ｅを（数８）で求め、次に各ピクチャタイプ（Ｉ、Ｐ、Ｂ）の平均誤差ＥｃとＧＯＰ全体での平均誤差Ｅｇｏｐを（数９）と（数１０）により計算する。

【００５２】

【数８】

$$Ei = \frac{\Sigma |Fin(x,y) - Fdec(x,y)|}{Npixel}$$

【数９】

$$Ec = \begin{cases} \dfrac{\min(Ec - Egop,\ Et)}{Et} & (Ec \geq Egop\text{の時}) \\ \dfrac{\max(Ec - Egop,\ -Et)}{Et} & (Ec < Egop\text{の時}),\ (c = i, p, b) \end{cases}$$

【数１０】

$$Ec = \frac{\Sigma E_c}{Nc},\ (c = i, p, b)$$

$$Egop = \frac{\Sigma E}{Ngop}$$

ただし、Ｎｐｉｘｅｌはピクチャを構成する画素数、Ｎｃは各ピクチャタイプのピクチャ数、ＮｇｏｐはＧＯＰのピクチャ数である。

【００５３】次に、量子化幅係数決定部２５において、各ピクチャタイプの平均誤差ＥｃをＧＯＰ全体での平均誤差Ｅｇｏｐと比較する。もしＩピクチャの平均誤差ＥｉがＧＯＰの平均誤差Ｅｇｏｐより大きければ、Ｉピクチャの画質が相対的に悪いと判断し、Ｉピクチャの量子化幅係数Ｋｉを小さくなるように補正する。ＰピクチャとＢピクチャについても同様の補正を行う。各ピクチャタイプにおける量子化幅係数の補正は（数１１）と（数１２）により行う。

【００５４】

【数１１】

【数１２】

$$Kc = (1 + w \cdot Zc) \cdot Kc,\ (c = i, p, b)$$

ただし、（数１２）における“＝”は代入を意味する。また、Ｅｔは画質評価値を－１から１の範囲に正規化するためのしきい値、Ｚｃは各ピクチャタイプの画質評価値、ｗは画質評価値の重み係数であり、例えば０≦ｗ≦０．２のように定める。ここで、ｗの上限値を定めるのは量子化幅の過剰な補正を防ぐためであり、この値は０．２でなくてもかまわない。

【００５５】以上の方法により、量子化幅係数Ｋｉを補正し、Ｉピクチャの量子化幅を調整することによって、Ｉピクチャの画質をＰピクチャとＢピクチャの画質に近づけることができる。ＰピクチャとＢピクチャに関しても同様である。

【００５６】即ち、量子化幅係数決定部２５によりＩピクチャの平均誤差とＧＯＰ全体での平均誤差からＩピクチャの量子化幅係数を決定し、ＧＯＰ量子化幅決定部２６により所定の符号化レートとバッファ１３における発生符号量の推移からＧＯＰの基準量子化幅を決定し、ピクチャ量子化幅決定部２７により、これらＧＯＰの基準量子化幅とＩピクチャの量子化幅係数から符号化対象とするピクチャの量子化幅を決定し、量子化幅制御部２８から与えられる量子化幅により符号化部２２が符号化を行うことにより、Ｉピクチャの画質をＰピクチャとＢピクチャの画質に近づけることができる。ＰピクチャとＢピクチャに関しても同様である。

【００５７】このように、本実施の形態２によれば、符号化した動画像信号の復号画像における画質評価値を算出し、ＩピクチャとＰピクチャとＢピクチャのそれぞれについて画質を直接評価することによって、各ピクチャの画質が均一となるような符号化を可能とするフィードバック制御が可能となる。

【００５８】なお、本実施の形態２においては、入力画像と復号画像に対する誤差の算出処理をマクロブロック単位で行うことにより処理遅延およびメモリ容量を削減することができるが、誤差の算出処理はフレーム単位でもＧＯＰ単位でもかまわない。

【００５９】また、本実施の形態２においては、ＧＯＰを単位として復号画像の画質評価を行っているが、画質評価の単位は特にＧＯＰでなくてもよい。また、画質評価に用いる情報についても、入力画像と復号画像の画像間差分量だけに限らず、例えばＳ／Ｎ比のように（請求項８，１６に対応）復号画像の画質を評価できる情報であればどのような情報でもよい。

【００６０】また、以上の実施の形態１，２においては、Ｍ＝３、Ｎ＝１５のＧＯＰ構造（ＭはＩピクチャまたはＰピクチャの挿入間隔、ＮはＧＯＰのピクチャ数）で、ピクチャ構造がフレーム構造の場合を例に挙げて説

明したが、MとNは異なる値でもよい。さらに、各ピクチャのピクチャ構造はフレーム構造でもフィールド構造でもかまわない。

【００６１】なお、本発明はプログラムによって実現し、これを記録媒体に記録することにより、コンピュータシステム上で符号化装置として実施することができる（請求項１７に対応）。

【００６２】また、図６に示すように、前述の符号化装置１００において符号化されたストリームを記録媒体２００に記録することにより、均一な画質で復号が可能な符号化ストリームを記録した記録媒体が得られる（請求項１８に対応）。

【００６３】また、この符号化されたストリーム自体またはこれを一旦記録媒体に記録し再生されたストリームを再生するにあたっては、復号装置３００としては特別な装置は必要とせず、従来の符号化装置に対応する復号装置と同様の復号装置でこれを再生することが可能であり、しかもその復号を均一な画質で行うことが可能である（請求項１９に対応）。

【００６４】その理由は、本発明による符号化が、画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する，という前提のもとで符号量の割り当ての均一化を行うため、復号装置は単に画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化方式に対応していればよいからである。

【００６５】

【発明の効果】以上のように、本願の請求項１記載の発明に係る動画像符号化装置によれば、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、前記動画像信号における時間方向の変化度を算出する時間方向変化度算出手段と、前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御手段とを備えるようにしたので、動画像信号の時間方向変化度を算出し、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質を均一化できる動画像符号化装置を実現できるという有利な効果が得られる。

【００６６】また、本願の請求項２記載の発明に係る動画像符号化装置によれば、請求項１記載の動画像符号化装置において、前記量子化幅制御手段は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくするようにしたので、時間方向変化度が小さいときにＩピクチャの量子化幅を相対的に小さくすることによって、復号の際にＩピクチャ周期で発生する画質の不均一さを防ぐことができる動画像符号化装置を実現できるという有利な効果が得られる。

【００６７】また、本願の請求項３記載の発明に係る動画像符号化装置によれば、請求項１記載の動画像符号化装置において、前記時間方向変化度算出手段は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化装置を実現できるという有利な効果が得られる。

【００６８】また、本願の請求項４記載の発明に係る動画像符号化装置によれば、請求項１記載の動画像符号化装置において、前記時間方向変化度算出手段は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させる動画像符号化装置を実現できるという有利な効果が得られる。

【００６９】また、本願の請求項５記載の発明に係る動画像符号化装置によれば、請求項１記載の動画像符号化装置において、前記時間方向変化度算出手段は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化装置を実現できるという有利な効果が得られる。

【００７０】また、本願の請求項６記載の発明に係る動画像符号化装置によれば、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置において、前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出手段と、前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御手段とを備えるようにしたので、動画像信号の局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅をフィードバック制御することによって、復号の際に画質を均一化できる動画像符号化装置を実現できるという有利な効果が得られる。

【００７１】また、本願の請求項７記載の発明に係る動画像符号化装置によれば、請求項６記載の動画像符号化装置において、前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記画質評価値を算出するようにしたので、局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化装置を実現できるという有利な効果が得られる。

【００７２】また、本願の請求項８記載の発明に係る動画像符号化装置によれば、請求項６記載の動画像符号化装置において、前記画質評価値算出手段は、入力された動画像信号と符号化時に得られる復号画像のＳ／Ｎ比を用いて前記画質評価値を算出するようにしたので、局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化装置を実現できるという有利な効果が得られる。

【００７３】また、本願の請求項９記載の発明に係る動画像符号化方法によれば、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、前記動画像信号における時間方向の変化度を算出する時間方向変化度算出工程と、前記時間方向変化度に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むようにしたので、動画像信号の時間方向変化度を算出し、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質を均一化できる動画像符号化方法を実現できるという有利な効果が得られる。

【００７４】また、本願の請求項１０記載の発明に係る動画像符号化方法によれば、請求項９記載の動画像符号化方法において、前記量子化幅制御工程は、前記時間方向変化度が小さい場合に画面内符号化の量子化幅を前方向予測符号化と双方向予測符号化に対して量子化幅を相対的に小さくするようにしたので、時間方向変化度が小さいときにＩピクチャの量子化幅を相対的に小さくすることによって、復号の際にＩピクチャ周期で発生する画質の不均一さを防ぐことができる動画像符号化方法を実現できるという有利な効果が得られる。

【００７５】また、本願の請求項１１記載の発明に係る動画像符号化方法によれば、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、入力された動画像信号における画像間の差分情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させる動画像符号化方法を実現できるという有利な効果が得られる。

【００７６】また、本願の請求項１２記載の発明に係る動画像符号化方法によれば、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、符号化前に割当てた符号量と符号化後に得られる発生符号量の情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させる動画像符号化方法を実現できるという有利な効果が得られる。

【００７７】また、本願の請求項１３記載の発明に係る動画像符号化方法によれば、請求項９記載の動画像符号化方法において、前記時間方向変化度算出工程は、符号化時に得られる動きベクトルの情報と符号化モードの情報を用いて前記時間方向変化度を算出するようにしたので、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させる動画像符号化方法を実現できるという有利な効果が得られる。

【００７８】また、本願の請求項１４記載の発明に係る動画像符号化方法によれば、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化方法において、前記動画像信号の，復号画像に対する画質評価値を算出する画質評価値算出工程と、前記画質評価値に応じて画面内符号化と前方向予測符号化と双方向予測符号化の量子化幅を制御する量子化幅制御工程とを含むようにしたので、動画像信号の局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅をフィードバック制御することによって、復号の際に画質を均一化できる動画像符号化方法を実現できるという有利な効果が得られる。

【００７９】また、本願の請求項１５記載の発明に係る動画像符号化方法によれば、請求項１４記載の動画像符号化方法において、前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像の画像間差分量を用いて前記画質評価値を算出するようにしたので、局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化方法を実現できるという有利な効果が得られる。

【００８０】また、本願の請求項１６記載の発明に係る動画像符号化方法によれば、請求項１４記載の動画像符号化方法において、前記画質評価値算出工程は、入力された動画像信号と符号化時に得られる復号画像のＳ／Ｎ比を用いて前記画質評価値を算出するようにしたので、局所復号画像の画質評価値を算出し、この画質評価値に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質の均一性を向上させることができる動画像符号化方法を実現できるという有利な効果が得られる。

【００８１】また、本願の請求項１７記載の発明に係る記録媒体によれば、請求項９ないし１６のいずれかに記載の動画像符号化方法を実行させる動画像符号化プログラムを記録するようにしたので、動画像信号の時間方向変化度を算出し、この時間方向変化度に応じて各ピクチャの量子化幅を制御することによって、復号の際に画質を均一化できる符号化プログラムを収録した記録媒体が得られる効果がある。

【００８２】また、本願の請求項１８記載の発明に係る記録媒体によれば、請求項１ないし８のいずれかに記載の動画像符号化装置により符号化されたストリームを記録するようにしたので、復号の際に均一な画質で復号が可能な符号化ストリームを収録した記録媒体が得られる効果がある。

【００８３】また、本願の請求項１９記載の発明に係る動画像復号方法によれば、請求項１ないし８のいずれかに記載の動画像符号化装置により符号化されたストリームを復号する方法であって、上記ストリームを復号する際、動画像信号を入力とし、前記動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置により符号化されたストリームを復号する復号装置を用いて復号を行うようにしたので、こうした復号画質の均一化が可能な符号化装置に対応した特別な復号装置を用いる必要がなく、単に動画像信号を画面内符号化と前方向予測符号化と双方向予測符号化のいずれかを選択して符号化する動画像符号化装置により符号化されたストリームに対応する復号装置であれば、均一な画質で復号が可能な符号化ストリームの復号を実行できる、動画像復号方法が得られる効果がある。

【図面の簡単な説明】

【図１】本発明の実施の形態１における動画像符号化方法の構成を示すブロック図

【図２】本発明の実施の形態２における動画像符号化方法の構成を示すブロック図

【図３】各ピクチャを予測符号化する時に参照画像として用いるピクチャを示す図

【図４】本発明の実施の形態１と従来方法における各ピクチャの発生符号量を示す図

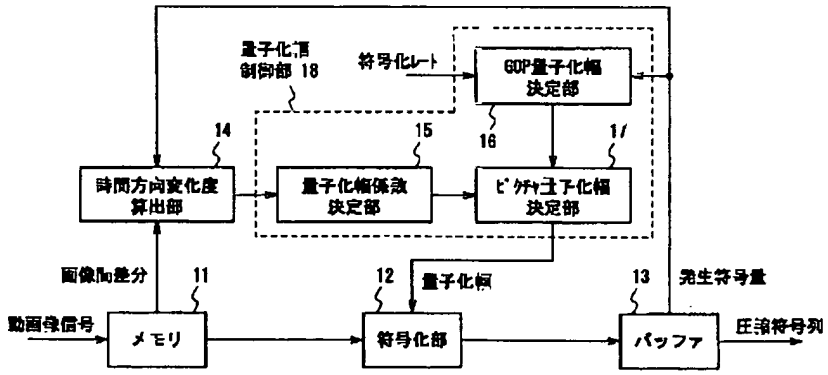
【図５】本発明の実施の形態１と従来方法における各ピクチャのＳ／Ｎ比を示す図

【図６】本発明を記録媒体および復号装置と組み合わせた実施形態を示す図

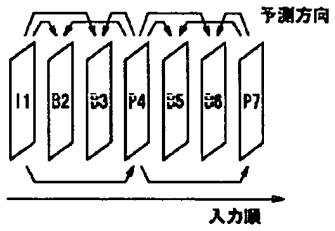
【符号の説明】

１１，２１　入力画像格納用メモリ
１２，２２　符号化部
１３，２３　圧縮符号列出力用バッファ
１４　時間方向変化度算出部
２４　画質評価値算出部
１５，２５　量子化幅係数決定部
１６，２６　ＧＯＰ量子化幅決定部
１７，２７　ピクチャ量子化幅決定部
１８，２８　量子化幅制御部

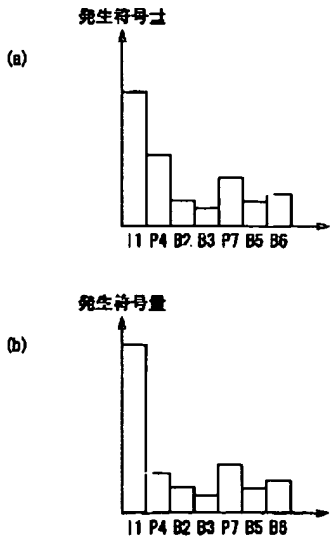
【図１】



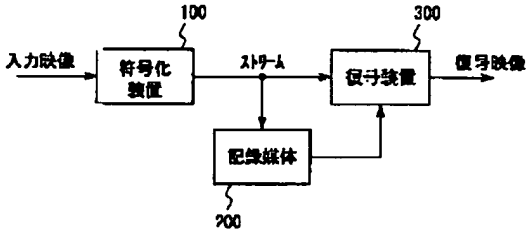
【図３】



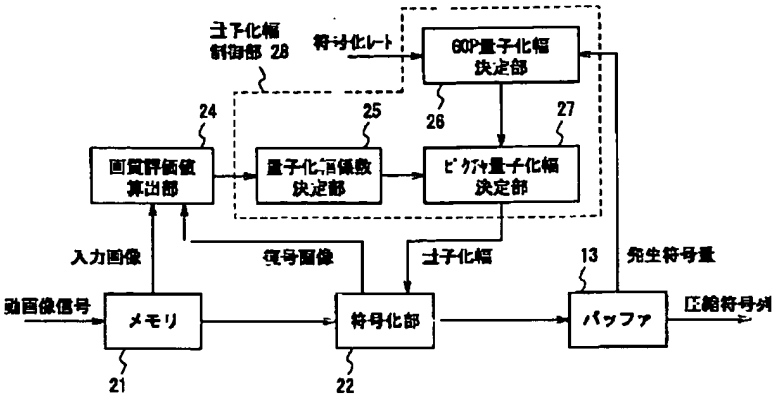
【図４】



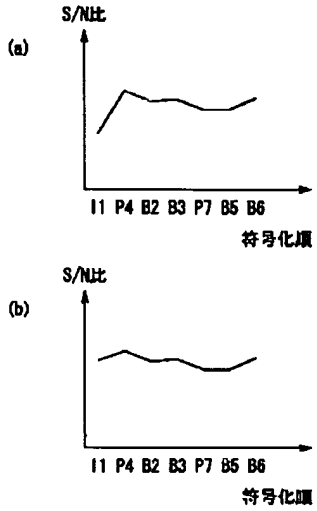
【図６】



【図2】



【図5】



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